of the sense current and the resistance change, and the resistance change is proportional to the product of the resistance change rate and the sheet resistance of the spin valve film. Therefore, the cases in which only the resistance change rate is large could not produce high output if their sheet resistance is small. In other words, in order to attain high output, both the resistance change rate and the sheet resistance must be high.

Fig. 23A, Fig. 23B and Fig. 23C are graphs of resistance change in spin valve films in which the thickness of the ferromagnetic layer A is fixed to be 3 nanometers and that of the ferromagnetic layer B is varied, versus the applied magnetic field.

As in Figs. 23A to 23C, when the thickness of the ferromagnetic layer A is the same as that of the ferromagnetic layer B, the resistance change in the spin valve film in a high magnetic field of +600 Oe is small. In that case, therefore, the pinned magnetic layer is extremely stable to the ambient magnetic field, to the magnetic field from the longitudinal bias layers and to the applied magnetic field in thermal treatment for forming the recording part. As so mentioned hereinabove, the problem of magnetization reversal in the pinned magnetic layer to be caused by ESD could be solved by the current circuit as incorporated in the drive and capable of correcting the pinning magnetization direction to be in a

predetermined direction.

On the other hand, the different thicknesses of the ferromagnetic layers A and B have the following advantages: The first is that the thermal treatment for magnetization pinning is easy, which is indispensable for ensuring the basic constitution of the spin valve film where the magnetization of the free layer is perpendicular to that of the pinned magnetic layer. The second is that, when the thickness of the ferromagnetic layer B is smaller than that of the ferromagnetic layer A, the resistance change rate is increased, as in Table 10 showing the relationship between the varying thickness of the ferromagnetic layer B and the resistance change rate. The third is that the magnetization reversal to be caused by ESD occurs little in the pinned magnetic layer, and stable reproduction output is possible even high voltage of around the breakdown voltage. The breakdown voltage as referred to herein is meant to indicate the voltage at which the spin valve device is broken and the spin valve device resistance begins to increase.

Table 10

Spin Valve Film Constitution:

5 nanometer Ta/2 nm AuCu/5 nm CoFe/3 nm Cu/ferromagnetic layer A (CoFe)/0.9 nm Ru/ferromagnetic layer B (CoFe)/10 nm IrMn/5 nanometer Ta

Thickness of ferromagnetic Layer A (nm)	Thickness of ferromagnetic Layer B (nm)	Resistance Change Rate $\Delta R/R$ (%)
3	3	7.3
3	2.5	7.8
3	2	7.7

For example, when the ferromagnetic layer A, the ferromagnetic layer and the free layer are of any of Co, CoFe and NiFe, while the nonmagnetic spacer layer is of Cu, and when the ratio of the magnetic thickness of the layer A to that of the layer B is varied within a range between 0.7 and 0.9 while the thickness of the ferromagnetic layer B is 2.5 nanometers, then the spin valve films have good ESD resistance, as in Figs. 24A and 24B, Figs. 25A and 25B and Table 11. Figs. 24A and 24B, and Figs. 25A and 25B are graphs of resistance versus output in spin valve devices to which has been applied a simulation ESD voltage by a human body model. In Figs. 24A and 24B, the thickness of the ferromagnetic layer A is the same as that of the ferromagnetic layer B; and in Figs. 25A and 25B, the former is larger than the latter. Table 11 shows the ESD